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CROP DEFENSE AND COPING STRATEGIES: WILDLIFE RAIDS IN MAHIGA 'B' VILLAGE IN NYERI DISTRICT, KENYA

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ABSTRACT This paper analyzes the different methods used by farmers in the study village to deter wildlife from raiding crops and examined strategies for coping with losses that resulted from wildlife raids. Farmers employed 36 methods to protect crops from wildlife raids and seven strategies to cope with crop loss due to wildlife raids. The majority of the households in the study village utilized between one and three methods of defense simultaneously, whereas three utilized eight methods simultaneously, and one used seven methods simultaneously. The mean number of methods used per household was 3.09. None of the methods was 100% effective, but the persistence with which farmers used the methods indicate that they perceived them to be of some help. The diversity of defense methods reflected the diversity of wildlife that raided crops. Wildlife habituated to the defense methods and posed serious challenges to the farmers. Households close to Solio Ranch employed more defense methods than did those farther away, indicating that farms close to the ranch were more vulnerable to wildlife raids.

Key Words: Defense methods; Guarding; Coping strategies; Wildlife; Crop raiding; Mahiga 'B'; Solio.

INTRODUCTION

Farmers attempt to protect their crops from wildlife by increasing the risks faced by potential predators. These defense strategies were designed to exploit an animal's tendency to avoid foraging in risky areas by employing stimuli that increase an animal's fear of the places where crops are planted. The fear-provoking stimuli consisted of objects with visual, auditory, or gustatory olfactory characteristics that increased an animal's wariness or fear (Gary, 1993). Habitat modifications, such as removing the cover used to hide from predators, were also used to increase an animal's fear of an area.

In some areas, divine intervention was invoked by farmers. In north-eastern Nigeria, farmers used fetish charms to protect their farms from wildlife (Ezealor & Giles, 1997). Knight (2004) reported that Japanese villagers used wolf charms (*ofuda*) obtained from wolf shrines and placed these in the local shrine or buried them in the fields to protect crops from forest herbivores. Knight (2004) further observed that Japanese farmers' preoccupation with safeguarding these fields, their means of subsistence, formed the basis for their representation of the wolf as a guardian spirit. The Akamba people, who live around Ol Donyo Sabuk National Park in Kenya, sang curse words, directed at

animals that stole their crops, while they worked (Lelo, 1994). Rice farmers in the Bukit Barisan area of Sumatra marked the borders of fields with specific plants they believed were disliked by the spirits of the forest to discourage the wild animals that belong to the spirits from eating the rice (Bakels, 2004). The farmers also attempted to placate the spirits and maintain a balanced relationship with the forest through rituals. In another part of Sumatra, Malay farmers, who were predominantly Muslim, established close relationships with hunter-gatherers, who guarded the fields and kept the meat of the wild pigs they killed (Persoon & de Iongh, 2004).

Saj et al. (2001) reported that farmers in Entebbe, Uganda changed what they grew in an effort to plant crops that were less vulnerable to raiding by vervet monkeys. The Japan Wolf Association has made many attempts to reintroduce wolves to upland Japan so that they can prey on crop-raiding species, such as wild boar, monkeys, and deer, for the benefit of upland farmers (Knight, 2004). Interestingly, it has been reported that farmers in some areas did not take any measures to protect their crops, despite losing them to wildlife. For instance, in Gabon, only 36% of interviewed farmers (N = 2,926 families) reported doing something to deter wildlife raids (Lahm, 1996).

Because local technologies and techniques are specific to particular environments, socio-economic situations, and cultures, research must be site- and case-specific (Hill, 1997). Previous studies of the methods used by farmers to deter wildlife raids on farms have been performed (Newmark et al., 1994; Omondi 1994; Lelo, 1994; Lahm, 1996; Hill, 1997; Naughton-Treves, 1996; Hill, 2000; de Boer & Ntumi, 2001). Detailed accounts of how the methods are employed reveal the extent to which protection of crops is difficult and complex. This paper describes the methods used by farmers in the study village to deter wildlife from raiding crops and discusses the difficulties they encountered as they attempted to do so. It also demonstrates that the target wildlife adopted behaviors that enabled them to circumvent such methods even as households improved and changed them.

Defense methods are actions taken by farmers to deter wildlife from attacking crops. Coping strategies are specific actions taken by farmers to overcome the effects of crop raiding as well as to avoid crop raids on their farms.

STUDY AREA

Mahiga ‘B’ village is situated in a Labura sub-location in the Kieni West Division of Nyeri District in central Kenya (Fig. 1). It covers an area of 4 km^2. In 2005, the village had a human population of 342 persons from 63 households, yielding a human population density of 85.5 persons per km^2. Mahiga ‘B’ village borders Solio Ranch to the north, Sangare village to the east, Lower Labura and Mweiga General villages to the west, and Mahiga ‘A’ village to the south. Mahiga ‘B’ village is classified as a lower highland ranching zone (Ralph & Helmut, 1983). Solio and Sangare are privately owned livestock-rearing ranches that also contain resident and transient (elephants) wildlife (Fig. 2).

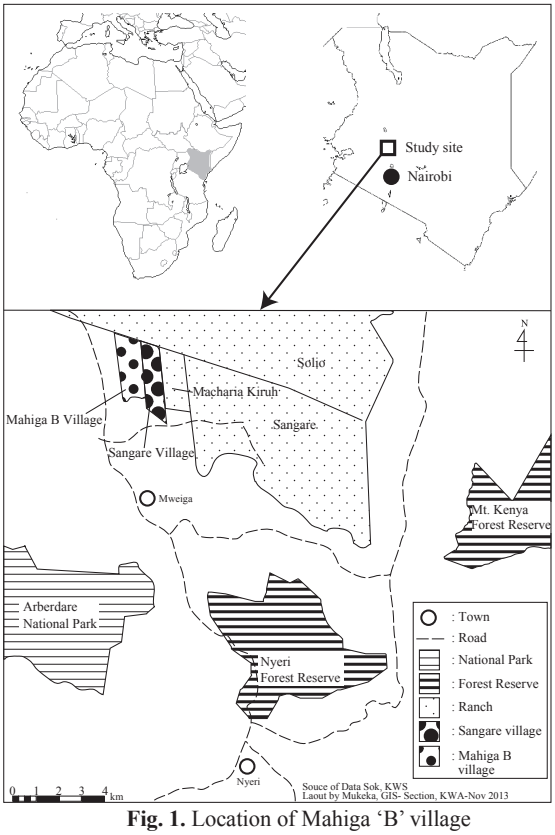

Fig. 1. Location of Mahiga 'B' village

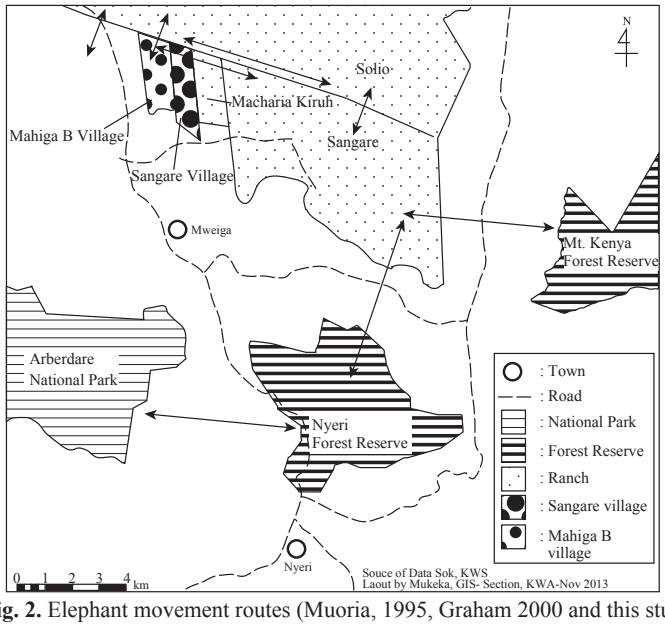

Fig. 2. Elephant movement routes (Muoria, 1995, Graham 2000 and this study)

METHODS

Fieldwork for this research was conducted for a total of 9 months from July 2004 to January 2006. Initial fieldwork was carried out in July/August 2004; this was followed by fieldwork conducted from October 2004 to January 2005 and from August 2005 to January 2006. I observed and recorded the methods of defense employed by farmers and the types of crops cultivated. I also interviewed farmers to determine whether the crop-protection methods were effective against the target species.

I measured the distance between the farms and Solio Ranch using a topographic map (1:50,000) showing the location of the farms relative to this Ranch.

During the fieldwork, I monitored how the farmers guarded their farms by collecting data about the dates of guarding, the times they started and stopped guarding, the identities of the target wild animals, the identities of the guards, and the guarding methods used.

RESULTS

Defense Methods

Table 1 presents the defense methods employed by farmers. All households reported that they used bodily movement to frighten animals, whereas 93.7% of the households ($N = 63$) said that they shouted at the animals. In most cases, these two methods were utilized simultaneously (i.e., shouting while making frightening bodily movements). The next most commonly used methods were mounting polythene papers on wooden sticks (38.1% of households), placing traps (33.3%), guarding (28.6%), beating on objects (27%), and using of guard dogs and harvesting of immature crops (17.5% each).

The majority of the households in the village (43 households) utilized one to three methods simultaneously, whereas three utilized eight different methods simultaneously, and one household used seven methods simultaneously. The mean number of methods used per household was 3.09. Table 2 presents the numbers of methods employed by households.

The data revealed a negative correlation between the number of defense methods employed by individual households and the distance of the household from Solio Ranch (Pearson's $r = -0.421$, $P = 0.001$, df = 62), indicating that households closer to Solio Ranch employed more defense methods than did households farther from Solio.

Table 1. Defense methods used by farmers

	Method	No. of farmers utilizing method	Percentage of total farmers
1.	Visual deterrents		
	Frightening bodily movements	63	100.0
	Mounting plastic papers	24	38.1
	Scarecrows	7	11.1
	Cassette compact tapes	4	6.3
	Video tapes	2	3.2
	Fires at night	8	12.7
	Sheathing maturing maize cobs	2	3.2
	Displaying dead animal parts	2	3.2
	Torchlights	5	7.9
2.	Auditory deterrents		
	Shouting	59	93.7
	Beating on objects	17	27
	Throwing objects	6	9.5
	Tying bells on ropes	1	1.6
	Mounting plastic papers	24	38.1
	Bothira (whip)	1	1.6
	Guard dogs	11	17.5
	Guard donkey	1	1.6
	Blowing a whistle	2	3.2
	Shotgun	1	1.6
3.	Gustatory deterrents		
	Planting a particular variety of beans	2	3.2
4.	Traps		
	Traps for yellow-necked spur fowls	21	33.3
	Traps for squirrels	3	4.8
	Traps for porcupines	2	3.2
5	Physical barriers		
	Fence improvements	3	4.8
	Construction of a wooden fence	1	1.6
	Trenches	1	1.6
	Sealing squirrel burrows	1	1.6
6.	Deceptive planting		
	Use of a maize nursery	1	1.6
	Applying a black substance to sowed maize seeds	2	3.2
	Planting many maize seeds in one hole	5	7.9
	Spreading soil after planting maize seeds	4	6.4
7.	Poisoning	4	6.3
8.	Shooting with arrows	1	1.6
9.	Harvesting immature crops	11	17.5
10.	Guarding	18	28.6

Table 2. Number of defense methods employed per household

No. of methods used	No. of households using method
1	14
2	16
3	13
4	6
5	5
6	5
7	1
8	3
Total	63

1. Visual Deterrents

1. Mounting Plastic Papers on Wooden Sticks

This method involved tying pieces of plastic paper of diverse colors to wooden branches and mounting them on the cultivated parts of farms to deter birds, Cape hares, and antelopes from raiding crops. This method uses both sight and sound to discourage wildlife from raiding crops. The vibration of the plastic papers produces a sound that is meant to frighten antelopes, and the sight of vibrating plastic papers is intended to scare birds. Twenty-four households employed this method, but it had limited success. Indeed, I observed birds attacking seeds and cotyledons immediately beneath the vibrating plastic papers on many farms.

Fig. 3. Mounting plastic papers on sticks

2. Scarecrows

Scarecrows, crude effigies of persons, were erected on the farms by the residents to scare birds and antelopes. The scarecrows served to frighten wildlife but were not, in themselves, dangerous. Seven farmers erected scarecrows on their farms. However, the scarecrows had limited effect. I personally observed bean plants located immediately beneath the scarecrows being raided by wildlife.

3. Use of Compact and Videocassette Tapes

Old cassette tapes and videocassette tapes were tied across farms to deter birds. The wind-induced vibrations of these tapes deterred birds from raid crops, as the vibrating tapes frightened the birds. Six households had tapes tied through the middle of cultivated fields from one end to the other. The success of this method varied from farm to farm. On some farms, crops were not raided, whereas others were raided despite the presence of the tapes.

4. Sheathing Maturing Maize

To protect maturing maize, two farmers sheathed the maize with socks, cattle horns, and plastic papers. On one farm, the maize was not attacked by wildlife, but it rotted. On the other farm, the maize was not attacked by other species, but elephants consumed the maize along with the sheaths.

5. Lighting Fires on Farms

Fire was another tool frequently employed by residents to scare crop-raiding species. Fire was used to deter all species that raided crops at night. The sight of fire and smoke and the smell produced by burning materials was intended to keep wildlife away from farms. It was said that wildlife have an aversion to smoke and to the smell associated with fire, and the night was thought to catalyze these effects as the darkness and stillness triggered the aversion. Many types of material (e.g., old clothes, plastics, rubber, dry cow or sheep dung, and sacks) were burned to scare away wildlife. Sometimes, diesel fuel was used to fuel the fire, darken the smoke, and intensify the odor. The success of this method varied. Fire alone seemed to have a limited effect, and its effectiveness was dependent on humans throwing stones and using torchlight. Bush pigs were found to have fed on Irish potatoes growing near a burning fire on one of the farms.

6. Use of Torchlight

Torchlight was used to scare away wildlife at night. This method had an effect similar to that of fires.

7. Displaying Dead Animal Parts

Fig. 4. Displaying the trunk of dead elephant

Parts of dead animals were placed on farms to serve as warnings to conspecifics: “this is what happened to your colleague.” I observed parts of an elephant killed in the village by Kenya Wildlife Service (KWS) in June 2004

being displayed by two households. A dry skin was placed in the middle of one farm, and the trunk was tied to a tree on the other.

2. Auditory Deterrents

1 Throwing Objects

Throwing objects, primarily stones, at wildlife assists in driving them away. The animals are either hit by the objects or the objects simply to fall to the ground, creating a sound that scares the animals away. When animals are hit, the pain and the fear of another round cause them to leave. The residents found the objects that they threw within their homesteads. They picked up what was available and threw it toward the animals. In other cases, farmers stockpiled the stones that they threw at night to scare the wildlife outside their houses.

2. Beating on Metallic Objects

Metal or wooden poles were used to beat on metallic objects to scare away elephants.

3. Blowing Whistles

Whistles were blown to deter elephants, in particular, as residents knew that elephants disliked the sound produced.

4. Use of a "Bothira"

A locally made flash whip, known by the local people as a *bothira*, was used to scare away elephants. This instrument is a short wooden pole with either a sisal rope or a rubber rope tied on one end. The sisal or rubber rope is flung in such a way that it produces a deafening sound, similar to that produced by firing a rifle, when it sways back and forth. During the night, the sound is can be heard over a long distance. This method was used to scare elands rather than elephants.

Fig. 5. Use of a '*bothira*'

5. Use of a Shotgun

One farmer was licensed to keep a shotgun, which was issued to him for his personal security. However, over the years, he has had to use the shotgun to deter elephants from raiding his and other households. The holder of the shotgun fired into the air to scare elephants. The limitations of using this approach in the village are discussed in the section on guarding.

6. Use of Guard Dogs

Domestic dogs chained on farms to guard crops barked when they sighted wildlife approaching. Some wildlife avoided farms that had guard dogs. Guard dogs were deployed during both day and night to guard against both diurnal and nocturnal crop raiders.

Dogs also played another important role in that their barking served as the primary signal of the approach of wildlife. Irrespective of whether they were chained on farms, dogs were an invaluable asset to the village as they have a good sense of smell and can detect animals before they enter a farm. When dogs barked at night, residents awakened and used torches to search for wildlife on their land. Dogs and torches comprised an important wildlife deterrence tool when used together.

Dogs were able to deter all species other than elephants, which would not normally be scared by their barking, from entering the farms. At times when the risk of elephants raiding farms was high, dogs were not chained on the farms because elephants that encountered such dogs would kill them.

Unchained dogs stop barking when elephants get too close lest the elephants turn their attention to the dogs. Thus, residents were alerted that elephants were on their farms when dogs suddenly stopped barking. In addition to barking, unchained dogs also chased other species off farms.

7. Use of a Guard Donkey

One farmer who owned a donkey used it to scare away wildlife that approached the farm at night. The donkey produced a sound that warded off antelopes in particular.

8. Tying a Rope with Bells

To deter elands, elephants, and bushbuck, one farmer tied a rope to her bed and extended it outside through an opening in the house. She attached metallic objects and bells to the rope and periodically pulled it so that the bells and metallic objects hit each other and produced a sound that scared wildlife away from her maize farm.

3. Gustatory Deterrents

1. Planting a Particular Variety of Beans

One variety of beans had leaves that were bitter and not palatable to wildlife. The seeds of this variety of beans, known in the local language as *kawairimu*, were planted to counter attacks from antelopes and Cape hares. This method worked for some farmers but not others.

4. Trapping

1. Yellow-Necked Spur Fowls

Traps were directed primarily at three species: yellow-necked spur fowls, porcupines, and squirrels.

5. Physical Barriers

1. Fences

Fencing was used to keep animals off farms, but this method was limited to the few households who could afford it. Even those households were able to fence only part of their land as fencing large parcels of land is expensive. Moreover, the erection of a fence that can deter wildlife increases the cost as elephants, elands, and porcupines can crush, jump over, and burrow, respectively, under fences. Nevertheless, some villagers reported a degree of success in deterring wildlife by improving their fencing.

Fig. 6. Trap for porcupines

2. Trenches

Trenches were dug uphill on farms to prevent wildlife from traveling up a slope by creating a hole into which they would fall. The trenches helped to safeguard Irish potatoes, in particular, from bush pigs.

3. Sealing Squirrel Burrows

The openings of squirrel burrows were sealed with stones, thereby trapping the animals, which then died of suffocation, starvation, or both.

6. Deceptive Planting

1. Planting Several Seeds in One Hole

Planting many maize seeds in one hole was another method employed by farmers to ensure that some seeds germinated after others were eaten by wildlife. Many seeds were planted in one hole, and seeds were placed in different parts of the hole and then covered with soil. This indicated that the farmers expected some of the seeds to be eaten by wildlife, but they also wanted some to germinate. Thus, they planted many seeds in one hole so that although birds ate some of the seeds, others would survive.

2. Spreading Soil after Planting

When planting maize, farmers spread the soil in such a way that wildlife could not ascertain where the seeds were planted. On many occasions, I observed that seeds were extracted from the very spot at which they were planted. At no time did wildlife move around the farm searching for seeds. Instead, they searched for seeds where the latter were, in fact, located, indicating that birds and squirrels could determine where the seeds were planted. This ability may have been related to disturbance of the soil during planting. Thus, farmers spread the soil at planting sites so that it appeared similar to that at sites at which no planting had occurred in an effort to deceive the wildlife.

3. Use of a Nursery

Maize seeds were planted in a nursery, and the saplings were then transplanted to the farm 4 weeks after germination to save the seeds from attacks by yellow-necked spur fowls.

4. Use of Carbon–Zinc Dry Cells

Maize seeds were smeared with the black substance contained in used zinc chloride dry cells before planting. The rationale behind this was that seeds

coated in the black color of carbon protected them from yellow-necked spur fowl as the birds would not see the usual white or pinkish color of uncertified or certified maize seeds. The farmers could deceive the birds because the latter rely heavily on sight for their survival. Palatable items are detected by experience and sight. Smearing a black color on seeds deceived birds that were searching for seeds, and employment of this method led to successful seed germination.

7. Poison

Poisoning was directed primarily at birds, but jackals and porcupines were also targets. Although other bird species were targeted, yellow-necked spur fowls was the main bird species targeted by this approach. Maize seeds or maize flour was laced with furadan, a common pesticide used by farmers that kills within a few minutes of consumption, or with rat poison. Other residents laced maize flour with alcohol, which immobilized birds after they consumed it.

8. Shooting with Arrows

Bows and arrows were used to shoot antelopes (bushbuck and dikdik) at night. When the antelopes entered, farms dogs barked to alert the owners, who would then shoot the antelopes.

9. Uprooting Crops that Attracted Wildlife

Residents removed plants or trees they regarded as attracting wildlife to their farms. This was primarily because when wildlife species are attracted to a farm by the presence of certain plants, they encounter other palatable crops and inflict additional damage.

10. Guarding

1. Time Spent Guarding from August to December 2005

Table 3 presents the data on the time spent guarding against wildlife from August to December 2005. During this period, nine households spent 470.1 hour guarding during the day (85.6% of total guarding time) and 78.94 hour guarding at night (14.4% of total guarding time). Guarding against yellow-necked spur fowls, speckled mouse birds, cape rooks, ring-necked doves, and squirrels accounted for 84.8% of the time spent guarding; this was performed during the day. Guarding against elephants, porcupines, and gray duikers was performed at night.

Table 3. Time spent guarding against wildlife from August to December 2005

Animal	Total time spent guarding (hour)	Percentage of total time spent guarding
Yellow-necked spur fowls (Ynsf), speckled mouse birds (Smb)	171.00	31.1
Ynsf	87.16	15.9
Ynsf, cape rooks (Cr) ring-necked doves, squirrels (Sq)	77.30	14.1
Grey duikers	64.83	11.8
Ynsf, Smb, Sq	60.00	10.9
Cape rooks	31.83	5.8
Speckled mouse birds	26.00	4.7
Squirrels	12.50	2.3
Elephants	10.75	2.0
Porcupines	3.50	0.6
Cape hare	3.50	0.6
Unidentified birds	1.00	0.2
Total	549.37	100.0

2. Opportunistic guarding

Guarding did not always require the physical presence of a person on the farm. At night, it could be performed by an individual who awakened periodically and visited the farm with a torch. Torchlight was then projected around the farm to drive away any animals present. In the case of opportunistic guarding against elephants, upon learning of their presence were on the farm, farmers left their homes and drove away the elephants. Table 4 summarizes the frequencies of opportunistic elephant-guarding in the village from October 2004 to January 2005.

The time taken to drive elephants from farms varied from 30 minute to 3 hours. In all cases, some form of damage was incurred. The time of elephant arrival also varied from as late as 8:00 pm to as early as 5:00 am. A double raid on one farm occurred on 13 January 2005.

3. Divine Defense

The residents frequently called on divine intervention to protect crops from wildlife. This approach was more common in efforts to deter difficult wildlife, such as elephants. After experiencing difficulties with driving away elephants and incurring the losses from their failure to do so, residents turned to God for intervention.

Table 4. Frequencies of opportunistic elephant-guarding from October 2004 to January 2005

Date (dd/mm/yy)	Times during which elephants were driven away	Amount of time	No. of households affected	Damage	No. of people involved
8/11/04	10:30 pm–1.30 am	3 h	3	Trampled young crops	2
14/11/04	12:00 am–2:00 am	2 h	3	Sugarcane, trampled wheat, Irish potatoes damaged, fence damage	4
18/11/04	1:00 am–1:30 am	30 min	1	Sugarcane damaged	3
24/11/04	5:00 am– 5:30 am	30 min	1	Guava tree damaged, gate broken, fence broken	1
20/12/04	8:00 pm–8:30 pm	30 min	2	Young crops trampled	3
12/1/05	9:30 pm–10:30 pm	1 h	1	Ripening wheatdamaged, fence broken	3
13/1/05	12:00 am–1:00 am	1 h	1	Ripening wheat damaged, fence broken	3
13/1/05	3:00 am–4:00 am	1 h	1	Ripening wheat damaged, fence broken	3

Coping Strategies

1. Leasing Additional Land

Some farmers leased farms away from their land due to losses incurred by wildlife raids.

2. Abandoning Farms

Five households abandoned parts of their farms that were close to Solio Ranch due to wildlife raids on crops. The mean distance of the five farms from Solio Ranch was 65.4 m. The farm that was nearest to Solio Ranch was 10.55 m distant, whereas the farm farthest from the ranch was 179.35 m distant.

3. Purchasing Food from the Market

Farmers were forced to buy food from the local market when they lost crops to wildlife.

4. Limitations on Crop Types

Crops such as sunflowers, sweet potatoes, sugarcane, bananas, and pumpkins were said to attract elephants and elands to farms. Pumpkins, sweet potatoes,

and sunflowers are ideally suited for the climatic conditions of the village, but elands are so fond of sweet potatoes that the presence of this crop on a farm continually attracted these animals. However, elephants frequented farms that contained pumpkins and/or bananas. Most farmers did not plant these crops for fear that they would attract these species.

5. Harvesting Immature Crops

Farmers were forced to harvest immature maize and beans in an attempt to save these crops from raids by primarily elephants, but also by elands and porcupines.

6. Cutting Down Trees

Although farmers had taken steps to plant trees for firewood and for environmental reasons, such as wind breaking and micro-climate regulation, some households were forced to cut down trees on or near their cultivated fields to deprive wildlife of roosting locations and escape cover. Upon realizing that the vegetation on or around fields offered protective cover, especially to birds, farmers removed the vegetation by cutting down trees or clearing bushes. The villagers also believed that some trees were highly palatable to elephants. These included pepper, avocado, casuarinas, guava, and grivellea trees. Whereas avocado and guava trees were planted for their fruit, pepper trees, *casuarina* sp., and *grivellea* sp. trees were planted for firewood and environmental reasons. Elephants fed on the barks of these trees whenever the latter were present on a farm.

7. Replanting Seeds

Raids on sowed seeds required that farmers replant seeds. Maize seeds, for instance, were replanted one to four times during the planting season from October to December, and one to three times during the planting season from August to December 2005.

Wheat, beans, and Irish potatoes were also replanted when wildlife raided the seeds. Beans were replanted one to two times, and both wheat and Irish potatoes were replanted once. Ten farmers replanted beans once, and one farmer replanted twice between October and December 2004.

Types of Defense Methods and Distance from Solio Ranch

There was a negative correlation between the number of defense methods employed by individual households and their distance from Solio Ranch (Pearson's $r = -0.421$, $P = 0.001$, df = 62). Thus households close to Solio Ranch employed more defense methods than did households farther away from Solio.

Number of Raiding Species and Distance from Solio Ranch

Figure 7, below, shows the numbers of wildlife species that raided farms in 2004 and 2005 as a function of distance from Solio Ranch.

When data for both years were combined, a negative correlation between the number of species that raided each farm and their distance from Solio Ranch was found ($r = -0.306$, $P = 0.002$, df = 60). This indicated that farms closer to Solio Ranch were raided by more species, and farms farther away from Solio were raided by relatively fewer species.

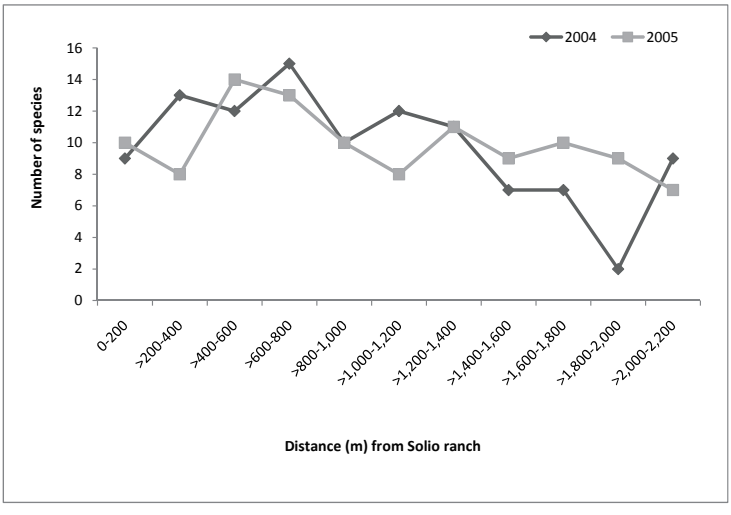

Fig. 7. Number of species of wildlife that raided farms in 2004 and 2005 as a function of distance from Solio Ranch

DISCUSSION AND CONCLUSIONS

Villagers employed numerous techniques to eliminate or at least limit the effects of raids by a wide range of wildlife species. Indeed, such assaults on the primary livelihood of the villagers called for far-reaching responses, which included the diverse defense methods and coping strategies employed by villagers. However, as will become evident, most defense methods did not remove the threat posed by wildlife. The diversity of crop-raiding wildlife and the variety of their feeding habits and behaviors posed severe challenges to any countermeasures. The residents were aware of the feeding habits of the wildlife and designed methods consistent with such behavior. However, the crop-raiding species rapidly learned and adapted to most methods. My fieldwork also showed that although residents continually improvised defense methods, the crop-raiding species adapted their behaviors to circumvent these innovations.

Farmers in the village employed numerous tactics to protect crops from wildlife attacks. Frightening bodily movement and shouting were the most commonly used tactics. The defense methods and coping strategies employed by households were not 100% effective. Wildlife became habituated to the methods used by farmers. Yellow-necked spur fowls and porcupines avoided traps. Similar results were reported in a related study conducted on the communal lands of Zimbabwe: Osborn and Parker (2002) reported that the local methods employed by farmers, such as burning fires, beating drums, and throwing stones, become less effective over time.

The success of the methods also varied among households. Whereas some methods were observed to be effective on some farms, the same methods were ineffective on others. The reasons for this variability were not apparent. However, residents continued using the methods because the methods worked on other farms. These results were similar to observations made elsewhere. Working in Entebbe, Uganda, Saj et al. (2001) found that no single method guaranteed success against crop raiding by vervet monkeys. Osborn and Parker (2002) reported that rural farmers in the communal lands of Zimbabwe lost considerable food and cash crops to elephants each year due to lack of resources and the ineffectiveness of any single defense method. Osborn and Parker (2003) noted that every field site has specific characteristics and that it is unlikely that any single method will work in all situations due to the influences of geographic, social, cultural, historical, political, and economic factors. Moreover, pest-management specialists consider the interplay of several factors when deciding the most appropriate set of techniques to use in combating an infestation in a crop field, and they usually adopt an approach involving successive or simultaneous rather than individual techniques (Ezealor & Giles, 1997).

The erratic and sporadic nature of rainfall in the study village had serious implications for agriculture. The removal of seeds planted at the onset of rains can have serious effects on farmers. To cope with this situation, villagers replanted seeds. However, the amount of rainfall decreases as the season progresses, rendering it difficult for replants to survive to maturity. As the study site was a semi-arid area, it was critical that the sowed seeds germinated with the initial moisture and then utilized subsequent rains for growth and development. Attacks on seeds made this difficult. Another consequence of replanting maize was that the maize plants were at different stages of growth.

It appeared that households close to Solio Ranch felt especially vulnerable to wildlife attacks and therefore did not invest substantially in farming the land located close to the Ranch. They instead utilized these portions of their farms for grazing. A similar observation was made on farms around Kibale National Park in Uganda, where crop raiding by elephants caused entire farms to be abandoned (Naughton-Treves, 1998). After persistent crop raiding in Gabon, people eventually abandoned farms in recognition of the attraction of elephants to nearby local resources, such as a swamp and fruit trees (Lahm, 1996). Households close to Solio Ranch employed more defense methods than did households farther away, indicating that households close to Solio Ranch were

more vulnerable to a greater diversity of wildlife species than were those farther away.

Farms containing pumpkins and/or bananas attract elephants, and so most farmers did not cultivate these crops. Similarly, elands are attracted to farms containing sweet potatoes, and so most farmers did not plant this crop. Similar observations have been reported from elsewhere in Africa. In a countrywide survey of Gabon, Lahm (1996) reported that farmers considered bananas to be the primary attractant for elephants. Lelo (1994) reported that farmers closest to Ol Donyo Sabuk National Park in Kenya were unable to grow food crops, such as sweet potatoes and pigeon peas, due to wildlife damage.

Campaigns by the local agriculture extension office were organized to encourage people to grow drought-resistant crops, such as sweet potatoes, sorghum, sunflowers, and pumpkins, which are suited to the climatic conditions in the village (Kagiri,[(1)] personal communication). However, these efforts were hampered by the risk that the crops would attract wildlife to the farms. Thus, wildlife limited the options available to the farmers for coping with drought conditions. Additionally, two farmers did not plant maize, a staple food for local people, because of previous losses to elephants.

The display of parts of dead elephants was employed as a warning to wildlife; however, this approach was not effective. Indeed, elephants raided a farm on which the trunk of a dead elephant was placed on a tree, trampled the immature wheat growing there, ate leaves from the tree on which the trunk was tied, broke the tree, and removed the trunk. The farmer, in turn, cut down the tree so that it would not again attract elephants to the farm. This dramatic aspect of African elephant behavior has been described in terms of their exploration and manipulation of the remains of dead conspecifics (Douglas-Hamilton & Douglas-Hamilton, 1975). The authors summarized unpublished observations of burying behavior, which is one component of this response: the elephants in Manyara National Park in Tanzania draped branches, leaves, grass, and soil over the carcasses. The materials were thrown or placed with the trunk or kicked up with the forefeet. Saj et al. (2001) reported that a farmer in Entebbe Uganda trapped and killed vervet monkeys and then placed the carcasses on trees on his property to keep other monkeys away.

Guarding crops against wildlife assumed two forms. One involved an individual watching over crops and driving away approaching wildlife. In some instances, driving away wildlife occurred independent of guarding, that is, when someone was not stationed on the farm and opportunistic guarding occurred. All species were guarded against, and guarding was organized at the household level as well as a collaborative effort among neighbors and neighboring villages. Because crops were raided during the day as well as during the night, guarding was performed during both the day and night.

Guarding was demanding as it required the physical presence of a person on a farm. It was also time consuming because feeding times varied among wildlife species. An understanding of the feeding times of the crop-raiding species was critical for the success of guarding. When this was understood, loses were

minimized. The most intensive and elaborate guarding involved a clear division of labor among household members.

Guarding was a complex matter. It needed to be sustained to achieve the best results. Guarding on consecutive days seemed to be the most effective approach, but making the time and recruiting the human labor necessary for sustained vigilance was difficult. Fatigue after 24-h guarding duty sometimes led to breaks in guarding. Indeed, farmers sometimes decided to take a break from this laborious activity. The wildlife usually took advantage of such lapses in guarding, even if they lasted for only a few minutes. This indicated that the wildlife were lurking nearby, waiting for the opportunity to raid farms. The presence of someone on the farm was effective for deterring wildlife, but only when sustained. This was not always possible, and losses were incurred when a break was taken after a period of successful guarding. In such instances, the crops, time, and labor invested in guarding were lost.

Guarding against elephants presented the greatest challenges, because of the danger they posed, especially when they refused to leave a farm that contained palatable crops.

A similar result was reported by Lelo (1994) regarding farmers living around Ol Donyo Sabuk National Park in Kenya, who noted that buffaloes refused to move out of ripening pigeon pea fields until they had had enough to eat, no matter how much noise was created to scare them away.

Farmers who individually attempted to drive elephants from their farms encountered aggressive behaviors from the elephants. Elephants simply would not move away from a farm containing palatable crops. When considerable pressure was put on the elephants by throwing stones or shining a bright torchlight, they responded in unexpected ways, such as by throwing objects or chasing the farmers. Elephants have been observed engaging in similar behaviors elsewhere. Beck (1980) reported personally observing captive African and Asian elephants aiming and throwing stones, soil, branches, grass, and feces toward both humans and large novel objects. Iain Douglas-Hamilton (Douglas-Hamilton & Douglas-Hamilton, 1975) described how Boadicea, a large matriarch who was a familiar figure in his Tanzanian field study, threw a log towards him. Although the log whizzed past his head and struck his vehicle, he did not conclude that the log was aimed.

Guarding against elephants was the most risky, difficult, and frustrating activity, and it involved considerable innovation. Residents burned an assortment of items, threw objects, shouted and screamed, beat on metallic objects, flashed torchlights, and revved vehicles. The residents also used a *bothira* (a whip that, when flung, produces a deafening sound), shone brilliant torchlight, and threw stones at elephants to drive them away. Guarding against elephants was the only guarding activity that involved a coordinated cooperative effort within and between neighboring villages. It also elicited cooperation among neighbors when the raids were localized.

Residents were alerted to the presence of elephants on their farms in several ways, including barking dogs, the sound of a fence or another farm struc-

ture breaking, a peculiar odor produced by elephants, and a peculiar sound produced by elephants' intestines. Residents were also alerted about the presence or approach of elephants by sounds produced by neighbors beating on metallic objects. Indeed, the village "woke up" at the sound of metallic objects.

Elephants do not give up easily. The prospect of a meal makes elephants adamant and even aggressive toward anyone who stands in their way. Elephants have been observed raising their heads while feeding in a field with mature wheat, looking at a person beating on and throwing objects at them, and then continue feeding as if nothing had happened. The residents reported that elephants had approached them when torchlight was directed at the animals. Amazingly, elephants threw objects at residents who attempted to drive them away from fields. During my fieldwork in 2004, an elephant chased one resident through his farm when he attempted to drive out two elephants. These reactions reflect the extremes to which elephants go to raid crops. It is little wonder that residents cite elephants as the worst of all the wildlife species that attacked crops in the village. Elephants engaged the villagers rather than moved away.

Protecting crops from wildlife posed serious challenges to the farmers, who had to be vigilant at both day and night during the entire agricultural season to ensure the successful development of their crops. However, this was not possible because their livelihood demanded that they engage in other social and economic activities. In this context, the farmers resorted to defense methods, which were only nominally successful in deterring wildlife as animals became habituated to the defense methods employed by the farmers.

RECOMMENDATION

Further research is needed to determine why farmers continue to use defense methods that are not effective.

NOTE

(1) Divisional agriculture and extension officer.

REFERENCES

Bakels, J. 2004. Farming the forest edge: Perceptions of wildlife among the Kerinci of Sumatra. In (J. Knight, ed.) *Wildlife in Asia: Cultural Perspectives*, pp. 147–164. Routledge-Curzon, Taylor & Francis Group, London and New York.

Beck, B.B 1980. Animal tool behaviour: the use and manufacture of tools by animals. Garland Publishing, New York.

de Boer, F. & C. Ntumi 2001. Elephant crop damage and electric fence construction in the Maputo Elephant Reserve, Mozambique. *Pachyderm*, 30: 57–64.

Douglas-Hamilton, I. & O. Douglas-Hamilton 1975. *Among the Elephants*. Collins & Harvill

Press, London.
Ezealor, A.U. & R.H. Giles 1997. Vertebrate pests of a Sahelian wetland agro-ecosystem: Perceptions and attitudes of the indigenous and potential management strategies. *International Journal of Pest Management*, 43(2): 97–104.
Gary, G.G. 1993. *Wildlife and People: The Human Dimension of Wildlife Ecology*. University of Illinois Press, Urbana and Chicago.
Graham, M. 2000. *Sangare/Thego Elephant Ranging Patterns, Conflicts and Conservation Options. A Report Prepared for the 1 Meeting of the Stakeholders in the Sangare-Thego-Mt. Kenya Corridor*. unpublished report.
Hill, C.M. 1997. Crop-raiding by wild vertebrates: The farmer's perspective in an agricultural community in western Uganda. *International Journal of Pest Management*, 43(1): 77–84.
——— 2000. Conflict of interest between people and baboons: Crop raiding in Uganda. *International Journal of Primatology*, 21(2): 299–315.
Knight, J. 2004. Wildlife in Asia: Cultural perspectives. In (J. Knight, ed.) *Wildlife in Asia: Cultural Perspectives*, pp. 1–12. RoutledgeCurzon, Taylor & Francis Group, London and New York.
Lahm, S.A. 1996. A nationwide survey of crop raiding by elephants and other species in Gabon. *Pachyderm*, 21: 69–77.
Lelo, F.K. 1994. *Humanisation of Wildlife Management: A Case Study of Ol Donyo Sabuk National Park, Kenya.* PhD, Clark University.
Muoria, P.K. 1995. *Elephant (Loxodonta africana Blumenbach) Abundance, Movements Andcrop Raiding in Nyeri District, Kenya.* MPhil thesis, Moi University, Kenya.
Naughton-Treves, L. 1996 *Uneasy Neighbors: Wildlife and Farmers around Kibale National Park, Uganda.* PhD thesis, University of Florida, US.
——— 1998 Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda. *Conservation Biology*, 12(1): 156–168.
Newmark, D.W., D.N. Manyanza, M.D. Gamassa & H.I. Sariko 1994. The conflict between wildlife and local people adjacent to protected areas in Tanzania: Human density as a predictor. *Conservation Biology*, 8(1): 249–255.
Omondi, P. 1994. *Wildlife–human Conflict in Kenya: Integrating wildlife Conservation with Human Needs in the Maasai Mara Region.* PhD thesis, McGill University, Canada.
Osborn, F.V. & G.E. Parker 2002. Community-based methods to reduce crop loss to elephants: Experiments in the communal lands of Zimbabwe. *Pachyderm*, 33: 32–38.
——— & ——— 2003. Linking two elephant refuges with a corridor in the communal lands of Zimbabwe. *African Journal of Ecology*, 41: 68–74.
Persoon, G.A & H.H. de Iongh 2004. Pigs across ethnic boundaries: Examples from Indonesia and the Philippines. In (J. Knight, ed.) *2004 Wildlife in Asia: Cultural Perspectives*, pp. 165-184. RoutledgeCurzon, Taylor & Francis Group, London and New York.
Ralph, J. & S. Helmut 1983. *Farm Management Handbook of Kenya, Vol II: Natural Conditions and Farm Management Information, Part B, Central Kenya (Rift Valley and Central Provinces.* Ministry of Agriculture, Kenya in cooperation with the German Agricultural Team (GAT) of the German Agency for Technical Cooperation (GTZ), Central Kenya.
Saj, T.L., P. Sicotte, & J.D. Paterson 2001. The conflict between vervet monkeys and farmers at the forest edge in Entebbe, Uganda. *African Journal of Ecology*, 39: 195–199.

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